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of at least two ages intrude this formation. Tertiary (probably) dikes and stocks of monzonite porphyry and bostonite porphyry cut all of the pre-Cambrian rocks.

The mineral veins, which are the products of combined fissure filling and replacement along a series of east to northeast striking fractures, traverse both the pre-Cambrian and Tertiary rocks; they are believed to be related to the monzonite intrusions. Pyritic and lead-zinc veins are represented.

A number of the specimens of the vein material show the contemporaneous origin of pitchblende, chalcopyrite, and probably minor amounts of pyrite and quartz. In other specimens the pitchblende is cut by veinlets of sulphides.

"It is believed that the pitchblende was deposited during the earlier or pyritic mineralization, that it was afterward fractured, and that the fractures thus formed were filled by sulphides of the later or lead-zinc mineralization."

The pitchblende ores apparently represent a local variation in the general sulphide mineralization of the area. They were formed under conditions of low temperature and pressure; this is true also of the Cornwall and Erzgebirge deposits. The European pitchblende occurs with cobalt and nickel minerals. No such association was observed in the case of the Quartz Hill pitchblende.

V. O. T.

Reconnaissance of the Grandfield District, Oklahoma. By MALCOLM J. MUNN. Bull. U.S. Geol. Survey, No. 547, 1914. Pp. 83.

The Grandfield district includes the southeastern part of Tillman County and the southwestern part of Cotton County in southern Oklahoma. The purpose of the report is to discuss the geology with special reference to possible oil and gas accumulations. The oldest beds exposed represent the lower portion of the Wichita formation (lower Permian). They consist of sandstone, shale, clay, and a clay-limestone conglomerate (the Auger conglomerate lentil) which is absent in places. The Grandfield conglomerate unconformably overlies the Wichita formation. It is composed of well-rounded pebbles, up to three inches in diameter, of quartz, quartzite, a few of granite, and fragments of chert, limestone, and silicified wood imbedded in a red clay-limestone matrix. It is exceedingly uniform in composition, appearance, hardness, and thickness (average 3-4 feet), is widely exposed, and "displays a structure that is

surprisingly conformable to the present topography, being high on the divides and low near the valleys." It probably will be correlated with some portion of the Seymour formation in Wichita County, Texas which is referred to the Pleistocene. The suggestion is made that the Grandfield conglomerate may not be a stream deposit.

Quaternary gravels, alluvium, dune sand, and soil mantle the older consolidated deposits.

The general structure of the Permian strata is based on the exposures of the Augur conglomerate. The most important structure is the southeast-northwest trending Devol anticline which crosses the district. To the north and parallel to this lies the Deep Red syncline. Minor anticlines and synclines are present. About one-half of the report is devoted to "detailed stratigraphy and structure of the exposed rocks by townships."

In the adjacent portion of northern Texas are located the Petrolia, Burkburnett, and Electra oil and gas fields. The "sands" are of Pennsylvanian age. Since similar beds evidently underlie the Permian in the Grandfield district, and since the structure of both places is comparable, the existence of commercial pools in the Grandfield district is very probable. Suggestions as to the location of test wells are given. The opinion is expressed that "accumulations of oil and gas in pools is due to the action of large bodies of water moving under both hydraulic and capillary pressure."

V. O. T.

Relation of the Wissahickon Mica-Gneiss to the Shenandoah Limestone and to the Octoraro Mica-Schist, of the Doe Run-Avondale District, Coatesville Quadrangle, Pennsylvania. By ELEANORA F. BLISS and ANNA I. JONAS. A dissertation (Bryn Mawr College). Pp. 64, pls. 5.

The authors conclude "that the Wissahickon mica-gneiss [pre-Cambrian] is separated from the Shenandoah limestone [Cambro-Ordovician] and from the Octoraro mica-schist [Ordovician] by a thrust fault, which has been obscured by post-Ordovician metamorphism."

V. O. T.